SYNOPSIS OF THE CARDITACEA AND OF THE AMERICAN SPECIES.

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This paper is in continuation of the series of similar synopses of groups of bivalve shells which the writer has prepared during the last few years, including the *Leptonacea, Tellinacea, Veneracea, Lucinacea, Cardiacea,* etc. The present paper contains a summary of the groups included in the *Carditidæ* and the *Condylocardiidæ,* and of the species reported to inhabit the Atlantic and Pacific coasts of America. Doubtless with a better exploration of the tropical and South American waters some additions may be expected to the list.

The group is intimately related to the *Crassatellitidæ, Astartidæ* and *Chamidæ,* as shown by its paleontologic history, anatomy and development. There are no siphons, the border of the mantle is pierced for the excurrent orifice, while the incurrent orifice may or may not be complete, but in most cases seems to be formed by the apposition rather than the organic connection, ventrally, of the edges of the mantle. The gills are coarsely reticular and usually united behind the foot. In many, if not all, cases the young are developed within the body cavity of the mother and retained there until some progress in secreting the nepionic shell has been made, in addition to the completion of the prodissoconch. This incubation in one group takes place in the atrium of the ovary, in another in a specially developed fold of the ventral part of the mantle lobes which secretes and lines a shelly marsupium which is absent in the shells of male individuals.

The species are usually sedentary, and mostly secrete a byssus by which they fix themselves when young, and in one large group this condition continues through life. The sculpture is predominantly radial and often strong, the periostracum conspicuous and frequently pilose; the valves, except in abyssal and minute species, are usually solid and heavy and their margins strongly crenate. The ligament in the *Carditidæ* is strong and wholly external; in

the *Condylocardiidæ* the resilium is immersed and the ligament feeble or obsolete.

The hinge-formula, when fully developed, as in *Carditamera*, is $\frac{L\ 01.01010.01}{R\ 10.10101.10}$, but in many forms the laterals are obsolete and the distal cardinals very feeble, coalescent with valve-margin or nymph, and hardly to be made out, so that in such forms as *Venericardia* the formula may be reduced to $\frac{L\ 0.0101.0}{R\ 0.1010\ 0}$. The hinge has never more than two left cardinals, the posterior one invariably long-drawn-out, a characteristic feature of the family, while the *Veneridæ* never have less than three left cardinals, so that convergent forms may readily be referred to their proper family. The teeth are usually finely striated. It is evident that with part of the hinge armature so liable to degeneration too much stress in classification must not be laid on such mutable features, and as a matter of fact the generally accepted subgeneric and sectional groups are chiefly based on external form, a character which proves unexpectedly constant when the groups are traced back through the line of their fossil progenitors.

The lunule is usually small, or even obsolete, and frequently unequally distributed between the valves, but when present is usually circumscribed by a deep, narrow sulcus, the termination of which on the inner left hinge-margin is frequently marked by a small but distinct pustule received into a dimple in the opposite valve; this pustule may or may not coincide with the left anterior lateral lamina. In *Beguina* the sulcus is so extended by the torsion of the hinge as to become tubular, though this perforation is probably closed by an organic plug in the living shell. The escutcheon is frequently linear or obsolete; when present it is usually limited by a ridge or keel. The pallial line is almost invariably entire, but in *Cardiocardita ajar* there is a broad posterior scar in front of the posterior adductor which simulates an indentation of the line and is probably caused by some enlargement of the siphonal muscles.

The valves are usually white within and the color of the exterior is dull, except in a few tropical species.

The group is of ancient origin and has Mesozoic representatives, but only those of Tertiary and Recent horizons will be considered here.

The living species are largely shallow water forms, especially the byssiferous types, but some of the minute species occur at considerable depths; the Arctic type, *Cyclocardia*, occurs in 822 fathoms (1,707 meters), and *Calyptogena* in 322 fathoms (669 meters).

In America *Cardita* s.s. and *Venericardia* s.s., *Miodon*, *Calyptogena*, *Milneria* and *Carditella* are restricted to the Pacific coast; while *Pleuromeris* and *Pteromeris* are known, so far, only from the Atlantic. The Pacific coast has twenty-seven and the Atlantic coast only twelve species of *Carditacea*, *Carditamera* with seven and *Cyclocardia* with fifteen being the most prolific in species.

Of those enumerated in this paper seven are new. It seems that the world musters, as a whole, only about sixty species; the two Americas thirty-nine, and the Pacific coast nearly half of all that are known.

The *Carditacea* are divided into *Carditidæ*, with the ligament and resilium external and united, and *Condylocardiidæ*, with the resilium immersed and the hinge in a more or less permanently imperfectly developed state.

The *Carditidæ* comprise two subfamilies: *Carditinæ*, with the marsupium dorsal, or superior, and not reflected in the structure of the valves; and *Thecaliinæ*, with the marsupium ventral, or inferior, and protected by an infolding or indentation of the inner shelly layer of the valves. The subdivisions of these groups are as follows:

Subfamily **CARDITINÆ.**

Genus **CARDITA** (Bruguière, 1792), Lamarck, 1799.

Type *Chama calyculata* Linné (+ *Mytilicardita* Anton, 1839; *Mytilicardia* Herrm., 1847).

Valves elongate-quadrate, strongly radially ribbed, very inequilateral and with a narrow byssal gape.

Section **Cardita** s.s.

Hinge with two left and three right cardinals, the laterals obsolete in the adult.

Section **Carditamera** Conrad, 1838.

Type *Cardita arata* Conrad.

Valves with the laterals well developed in the adult, the right

anterior cardinal often obsolete. *Lazaria* Gray, 1854, and *Lazariella* Sacco, 1899, are synonymous.

Section **Glans** Megerle, 1811.

Type *C. trapezia* Linné.

Valves short, quadrate, convex; shell small; the posterior right cardinal often obsolete.

Subgenus **BEGUINA** Bolten, 1798.

Type *Chama phrenetica* Born, 1780.

Shell large, mytiliform, subcompressed, with feeble, radial sculpture, the umbones terminal, the hinge arcuate and drawn out, the lunule tubular, the posterior cardinals much elongated, the laterals absent. *Azarella* Gray, 1854, is synonymous. A single Indo-Pacific species is known.

Genus **VENERICARDIA** Lamarck, 1801.

Type *V. imbricata* Lamarck, Parisian Eocene.

Shell rounded-trigonal, strongly radially ribbed, lunule minute and deep, escutcheon linear, the hinge with two transversely striated cardinals in the left and three in the right valve, a sublunular pustule sometimes present in the left valve, but the laterals absent or obsolete.

Megacardita Sacco, 1899, is synonymous.

Subgenus **CARDIOCARDITA** Anton, 1839.

Type *Cardita ajar* Bruguière.

Hinge like *Venericardia* s.s., pallial line with a broad scar in front of the posterior adductor scar; *Agaria* Gray, 1847; *Actinobolus* Mörch, 1853, and *Azaria* Tryon, 1872, are synonymous.

Subgenus **COSSMANNELLA** Mayer Eymar, 1897.

Type *Cardita ægyptiaca* Fraas, Eocene.

Shell elongate-oval, the cardinal teeth feeble, the ribs slender and distant, the pallial line entire.

Subgenus **CARDITES** Link, 1807.

Type *Cardita antiquata* Linné (sp.) = *C. sulcata* Bruguière.

Shell like *Venericardia* s.s., but the anterior right cardinal absent, the laterals obsolete.

Section **Cardites** s.s.

Shell with external coloration, frequenting the warmer seas.

Section **Cyclocardia** Conrad, 1867.

Type *Cardita borealis* Conrad.

Shell white, with a rude periostracum; frequenting the boreal seas or cold abysses. *Arcturus* Gray, 1839, not Cuvier, 1829; *Actinobolus* Morse, 1869, and *Scalaricardita* Sacco, 1899, are synonymous.

Subgenus **PLEUROMERIS** Conrad, 1867.

Type *Cardita tridentata* Say, not Reeve.

Shell small, subtriangular, subequilateral, the hinge like *Venericardia*, but the anterior and posterior right cardinals feeble, the left valve with feeble anterior and posterior laterals.

Subgenus **PTEROMERIS** Conrad, 1862.

Type *Astarte perplana* Conrad.

Shell small, high, oblique, with narrow umbones, radial ribbing, a well-marked lunule and escutcheon, the hinge as in *Cardites*.

Coripia De Gregorio, 1885, is synonymous.

Subgenus **MIODON** Carpenter, 1864 (not of Sandberger, 1870).

Type *M. prolongatus* Carpenter.

Shell not very different from *Pteromeris*, but not compressed, and with the posterior (instead of the anterior) right cardinal absent and a posterior right and anterior left lateral developed feebly.

Subgenus **NEOCARDIA** Sowerby, 1892.

Type *N. angulata* Sowerby, South Africa.

Shell small, wing-shaped, resembling *Pteromeris*. Hinge as in *Cardites* except that long posterior laterals are said to be present, with no anterior laterals, the cardinals diminutive.

Genus **CALYPTOGENA** Dall, 1891.

Type *C. pacifica* Dall. Pliocene and Recent.

Shell large, oblong, chalky, with only faint concentric sculpture, a well-marked escutcheon, but no lunule, the inner margins smooth, an anterior lateral in each valve; hinge formula $\frac{\text{L } .1010.10}{\text{R } .0101.01}$.

Subfamily THECALIINÆ.

Genus THECALIA H. and A. Adams, 1857.

Type *T. concamerata* Bruguière (sp.), South Africa.

Shell like a small *Carditamera* externally; the female has in each valve a funicular infold of the inner layer of the shell to serve as a marsupium, which, when the valves are closed, is completely internal; the male only a small byssal gape in the same region. Hinge with two cardinals in each valve, the posterior right cardinal absent, the middle right cardinal large and produced behind; there is an anterior lateral in each valve. The eggs are discharged into the marsupium, which is lined by a fold of the mantle, and remain there until the young shells are well advanced beyond the prodissoconch stage.

Genus MILNERIA Dall, 1881.

Type *Ceropsis minima* Dall, 1871. Recent. California.

Shell very small and trapezoidal, flattened on the ventral side; the female with a dome-like indentation of the ventral margins of the valves, which is closed below only by a fold of the mantle and not included within the closed valves; hinge with two left and three right cardinals, the posterior left lateral, posterior and anterior right cardinals minute and recognizable only in the best-developed specimens, which have the formula $\frac{\text{L } 1.01010.}{\text{R } 0.10101.}$. The male is byssiferous and the species habitually nestles on flat surfaces, particularly the backs of *Haliotis* shells.

The name *Ceropsis* being preoccupied since 1839 in *Coleoptera* by Solier, it was replaced by *Milneria*. The young are incubated as in *Thecalia*.

Cabralia (*Schmitzii*) Boehm, 1899, from the Miocene of the Azores, was referred to the *Carditidæ*, but appears to belong in the *Veneridæ* near *Venerupis*, its hardly sinuated pallial line being paralleled in *Chione*, etc.

Family CONDYLOCARDIIDÆ.

Genus ERYCINELLA Conrad, 1845.

Type *E. ovalis* Conrad (not of S. Wood). Miocene of Virginia.

Shell small, oval, radially sculptured, with the ligament external; the resilium internal and placed medially between two cardinals in

each valve, the lateral edges of the chondrophore slightly raised, so as to resemble in some specimens two feeble cardinals; feeble elongate posterior right and anterior left laterals fit into grooves in the opposite valve margins; the inner ventral margins crenulate.

Subgenus **CARDITELLA** E. A. Smith, 1881.

Type *C. pallida* Smith. Magellan Straits.

Valve trigonal, with strong radial sculpture with two cardinals in each valve, of which the right posterior is ill defined, the resilium sunken behind the two developed cardinals; the ligament is feeble, but there is a developed anterior and posterior lateral in each valve.

Subgenus **CARDITOPSIS** E. A. Smith, 1881.

Type *C. flabellum* Reeve. Chile.

Like *Carditella* except that the ligament is obsolete and the resilium sunken between the beaks as in *Erycinella*.

Genus **CONDYLOCARDIA** Bernard, 1897.

Type *C. pauliana* Bernard. Atlantic Islands.

Shell minute, with conspicuous prodissoconch, the hinge teeth only partially developed out of the nepionic state, so that it is difficult to decide what portions of a continuous lamina should be regarded as cardinal or lateral; subject to this caveat, the formula of the hinge of the type species is $\frac{\text{L } 1.10\text{r}101.0}{\text{R } 0.01\text{r}010.1}$; when compared with $\frac{\text{L } 0.10\text{r}01.1}{\text{R } 1.01\text{r}10.0}$, which is the formula of *Erycinella*, the relationship is fairly evident; the sculpture is variable in the different species, but predominantly radial as a rule, the animal viviparous, another link with the *Carditidæ*.

East American Species.

Cardita (Carditamera) gracilis Shuttleworth, 1856.

Blanquilla, Tortuga and Margarita Islands, Dautzenberg; Porto Rico, Blauner; Virgin Islands, St. Thomas, Swift; Tampa Bay, Florida, Coll. U. S. N. Mus., 54,141.

This is a small and delicate representative of *C. arata* of the Florida Pliocene.

Cardita (Carditamera) floridana Conrad, 1838.

Cape Canaveral on the east coast of Florida, thence south and west through the Gulf of Mexico to Yucatan, in shallow water.

Cardita gibbosa Reeve, 1843, is synonymous. Conrad, in 1832, figured an East Indian species on the strength of a valve said to come from Tampa Bay, which he identified with Sowerby's *C. incrassata*, and which was renamed *C. conradi* by Shuttleworth in 1856. This has been referred by Tryon, in 1872, to Tampa Bay, but the species was undoubtedly exotic and should be expunged from American lists.

? Cardita (Carditamera) pectunculus Bruguière, 1792.

Gulf of Paria, Guppy; South America, Hanley; Madagascar, Reeve (?).

I feel some doubt as to the species thus named by Guppy, having seen no specimens. Lister's shell so named by Bruguière may have been a large specimen of *C. gracilis*. The shell figured under this name by Reeve is almost certainly the West American *C. affinis* Broderip, and his locality erroneous.

?Cardita (Carditamera) minima Guppy, 1867.

West Indies; Trinidad ? Guppy. Also Pliocene.

A small, apparently immature species from Matura, Trinidad, is listed by Guppy in 1867 and 1874 among his Pliocene species, and noted as occurring also in the Recent state. These might well be the young of *C. gracilis*.

Cardita (Glans) dominguensis Orbigny, 1853.

Cuba and St. Domingo, Orbigny; Cape Hatteras, N. C., and southward to Florida and the Gulf of Mexico, in 36 to 124 fathoms; U. S. Fish Commission steamer "Albatross."

Readily recognizable by its squarish form with bright and variable yellow, red and brown coloration in the southern part of its range.

Venericardia (Cyclocardia) borealis Conrad, 1831.

Ashe Inlet, Hudson Strait, R. Bell; Labrador, Stearns, in 3 to 10 fathoms; and southward in gradually increasing depths of water, as the surface grows warmer, to the vicinity of Cape Hatteras, where it has been found living to the depth of 250 fathoms, and dead valves to 435 fathoms; the latter may, however, have been disgorged by fishes after the digestion of the soft parts.

This species has been referred to Say's *V. granulata*, a Miocene form which is smaller, more ventricose and less oblique, with fewer ribs. It is, in part, the *Arcturus rudis* of Humphrey (MS.),

according to Gray, in 1839, and the *Cardita vestita* of Deshayes, in 1852. The young are attached to stones in shallow water by a slender byssal thread, but the shells do not gape and the adults form no byssus. The females are viviparous, containing a multitude of young at the proper season, which are retained within the mother until the adult type of sculpture succeeds the smooth prodissoconch.

The type is elevated, oblique, rather convex, with the body of the valves subcircular, covered by a pilose periostracum on which small hairs are arranged in radiating lines. There are from fifteen to twenty-one low radial ribs, which in the young are usually more or less beaded. This species has not been reported from Greenland or Spitsbergen. The average temperature for seventy-four localities where it was found living was 55.35° F., the lowest 28°, and the highest 50° F.

Yoldia (Cytiocardia) borealis var. myalina Morse, 1869.

Newfoundland to Cape Cod, sparingly, with the typical form.

All the Provincardias have a normal and a more elongated form, which is usually more compressed. After the examination of a very large series, I find no other characters by which this variety may be separated from the type, those mentioned by Prof. Morse in his diagnosis being inconstant. The tendency is, however, for the number of ribs in the variety to be slightly less than in the type.

Yoldia (Cytiocardia) procera Conrad, 1850.

Off the mouth of the Rio Negro, Argentina, Wilkes Exploring Expedition.

Remarkably like *Y. borealis*, but more compressed, and with about 15 ribs. It should be compared with *Y. compressa* Reeve, 1856.

Yoldia (Cytiocardia) armilla Dall, 1902.

Between the Mississippi delta and Cedar Keys, Fla., in 24 to 196 fathoms, mud and sand, the bottom temperature 52° to 66° F. U. S. Fish Commission steamer "Albatross."

Small, convex, elevated, with 17–21 rather sparsely beaded ribs, with unequal, cross-striated channels and a smooth lunule of moderate size. It is much more elegantly sculptured than the young of *Y. borealis* of the same diameter.

Venericardia (Cyclocardia) moniliata Dall, 1902.

East of Rio Janeiro, in 59 fathoms, mud, bottom temperature 57° F.; U. S. Fish Commission steamer "Albatross."

Small, with rather large, distinctly limited, smooth lunule and escutcheon, and about 24 slender, closely beaded radial ribs, with subequal striated interspaces.

Venericardia (Pleuromeris) tridentata Say, 1826.

Off Cape Hatteras, N. C., and southward to Florida and the Gulf of Mexico, in 36 to 124 fathoms.

This is not the species figured by Reeve in 1843 under this name. The latter is an exotic. The present species is also found fossil in the Miocene and Pliocene Tertiary marls of the Atlantic coast.

Venericardia (Pteromeris) perplana Conrad, 1841.

Cape Hatteras, N. C., and southward to Florida and the Gulf of Mexico, from near low water to 52 fathoms. Also Upper Miocene and Pliocene of the Carolinas.

Small, oblique, wing-shaped, compressed and radially ribbed; sometimes rather bright-colored and always variable. *V. obliqua* Bush, 1885, is synonymous, and Conrad, after describing the fossil as a *Cardita*, put it, in 1845, in the genus *Astarte*, and, because of an earlier *Astarte perplana*, changed the specific name to *radians*. A year later he named the recent shell from Tampa Bay *Astarte flabella*. A shorter, more feebly sculptured form from the Yorktown and Duplin Miocene he named *Cardita abbreviata*, but this while the ruling form in the earlier beds is gradually supplanted by *V. perplana*, and I have not seen it in the Recent state.

Carditopsis smithii Dall, 1896.

Bermuda.

This is figured under the name of *Cardita dominguensis* Orbigny in the list of marine mollusks added to the fauna of the Bermudas by Verrill and Bush in *Trans. Conn. Acad. Sci.*, X, p. 517, Pl. LXIII, figs. 6, 7, 8, 1900. It is a minute brownish shell, subtrigonal in shape, with beaded radial sculpture and an internal resilium. No species of *Cardita* or *Venericardia* has as yet been identified from Bermuda.

Notes.

I have not been able to find in the literature the *Cardita minima* of Sowerby, to which Guppy refers a Recent and Pliocene form from Trinidad. The *Cardita "affinis* Shuttleworth" of Mörch's Poulsen catalogue, from the West Indies, is probably due to a momentary mental confusion between *C. gracilis* Shuttleworth and *C. affinis* of the Pacific coast. At any rate, I have not been able to discover any such species in the literature. *Cardita dactylus* Bruguière and *C. carditoidea* Blainville, from the Antilles, belong to *Coralliophaga*. *Cardita incrassata* Conrad is exotic, and *Cardita ovata* C. B. Adams, 1845, is *Venus pygmæa* Lamarck, as I have proved by an examination of the types at Amherst. I regard the Miocene *Venericardia granulata* Say, to which Conrad's *V. borealis* has been referred by Verrill and Bush, as sufficiently distinct. *Cardita arctica* Bruguière is referable to *Saxicava*.

West American Species.

Cardita Grayi Dall, 1902.

Cape St. Lucas, the Gulf of California and south to Panama and the Galapagos Islands.

Trapezoidal and inflated, this is a very recognizable species. The *Cardita incrassata* cited by Carpenter in 1864 from the Galapagos Islands is probably this species. It is *Cardita crassa* Gray in *Beechey's Voyage*, 1839, but not of Lamarck, 1819.

Cardita (laticostata) Sowerby,[1] 1832.

Guaymas, Mexico, and south to Panama and Guayaquil.

This shell has the aspect of *C. floridana*, but the hinge is destitute of lateral teeth, unless we regard the lunular pustule as a tooth. *C. tricolor* Sowerby, 1832, is a color variety, and *C. angisulcata* Reeve, 1843, has been claimed by Tryon, 1872, to be only a variety with flatter ribs and narrower channels. *Cardita turgida* Valenciennes, 1846, not Lamarck, 1819, is synonymous, according to Carpenter.

Cardita (Carditameral affinis Sowerby, 1832.

Margarita Bay on the west coast of Lower California, the Gulf of California, and southward to Panama.

Large, elongate, with small cardinal teeth; the northern speci-

[1] Not *Cardita laticostata* Pusch, 1837.

mens darker colored and larger, forming the variety named *Lazaria californica* by Deshayes in 1852. The ribbing is relatively stronger in the young, and in the adult is often obsolete anteriorly. The animals adhere by a strong byssus and, when crowded, the anterior end is arcuate and attenuated; but when growing freely this is much less marked. A specimen has been figured by Reeve for *C. pectunculus* Brug.

Cardita (Carditamera) radiata Sowerby, 1852.

Punta Arenas, Costa Rica, to Panama Bay and Guayaquil, in 6 to 12 fathoms.

Very similar to *C. affinis*, but with a very different hinge and more checkered coloration. The lunule is also larger and wider than in that species. *C. arcella* Valenciennes, 1846, figured on the plates of the *Voyage of the Venus*, but never described, may, perhaps, have been intended for this species.

Cardita (Carditamera) subquadrata Carpenter, 1865.

Skidegate Channel, Queen Charlotte Islands, in 20 fathoms, Newcombe; Straits of Fuca and southward to the Santa Barbara Channel and Todos Santos Bay, Lower California.

Small, solid, subquadrate, speckled with brown. The soft parts are yellow with brown spots on the mantle edge.

Cardita (Glans) sulcosa Dall, 1902.

Panama Bay, in 18 to 30 fathoms, sand; U. S. Fish Commission steamer "Albatross."

Small, quadrate, variegated in color, with a deep sulcus in the posterior end which emarginates the border of the shell.

Cardita (Glans) naviformis Reeve, 1843.

Valparaiso, Chile, in 25 fathoms, sandy mud, Cuming.

Small, rectangular, very inequilateral, the beaks almost terminal, the posterior end squarely truncate, with 12–15 scaly ribs.

Venericardia crassicostata Sowerby, 1825.

Gulf of California and southward to the Galapagos Islands.

This fine, variably colored species is *Cardita flammea* Michelin, 1830, *C. tumida* and *varia* of Broderip, 1832. The differences are merely of color, the form being very uniform. The *Cardita crassicosta* of Lamarck is a typical *Cardita*, but if the name given by Sowerby in the Tankerville catalogue be thought too close, Michelin's name must be adopted.

Venericardia Cuvieri Broderip, 1832.

Gulf of Fonseca, in 11 fathoms, 7 miles off shore, Cuming; and south to Panama.

C. michelini Valenciennes, 1846, is synonymous. This fine species with heavy crenate ribs can hardly be mistaken for any other. It appears to be exceptionally rare.

Venericardia (Cyclocardia) spurca Sowerby, 1832.

Iquique, Peru, and southward to the west coast of Patagonia, in 61 fathoms, bottom temperature 54° F.

An inflated rotund species with about 20 narrow beaded ribs, with wider interspaces and covered with an olivaceous gray periostracum.

Venericardia (Cyclocardia) velutina Smith, 1881.

Port Rosario and Wolsey anchorage, 17 to 30 fathoms, sand and rock, Smith; west coast of Patagonia and Magellan Straits, in 77 to 369 fathoms, mud, bottom temperature 46° to 48° F.; U. S. Fish Commission steamer "Albatross."

Much like *V. spurca*, but a thinner and lighter shell more delicately sculptured, with a larger and longer lunule and a very much more delicate hinge. It has about 20 ribs.

Venericardia (Cyclocardia) compressa Reeve, 1843.

Valparaiso, Chile; Portland Bay, West Patagonia, and in 20 fathoms, stony and shelly bottom, Boija Bay, Smith.

I have not seen this species, but from the figures it must be close to Gould's *V. procera*, and if the species extends in the cold water on both coasts of the southern part of South America, as some others do, they may be identical, and in that case Reeve's name has precedence.

Venericardia (Cyclocardia) barbarensis Stearns, 1890.

Station 2,840, in the Santa Barbara Channel, in green mud, at the depth of 276 fathoms, and at Station 2,909, in 205 fathoms, bottom temperature 45.2° F.; U. S. Fish Commission steamer "Albatross."

Shell very thin and delicate, with about twenty low ribs, slightly granular in the young and becoming obsolete distally in the adult, the lunule small and obscure.

Venericardia (Cyclocardia) ventricosa Gould, 1850.

Puget Sound, U. S. Exploring Expedition; Vancouver Island (Newcombe), and southward to Los Coronados Islands off Lower California, living in 31 to 252 fathoms, soft bottom, temperature 43 2° to 58° F.

A small, plump, rounded species, with 20–21 low, broad, radial ribs, with shallow narrower interspaces, crossed by flattish narrow concentric ridges, recalling basket-work, and covered by a gray or yellowish-brown velvety periostracum, the hairs of which are disposed in radial lines. Gould's types comprised two species, of which one which he figured is selected to carry his name. The other, represented by a single specimen, was unfortunately figured as his type in *Proc. U. S. Nat. Mus.*, XIII, Plate XVI, figs. 5 and 6, in 1890. It was not until this revision was undertaken that the discrepancy was observed. Gould's diagnosis refers partly to each species.

Venericardia (ventricosa var.?) Gouldii Dall.

Station 2,923, in 822 fathoms, mud, off San Diego, Cal., bottom temperature 39° F.; U. S. Fish Commission steamer "Albatross."

Shell ovate, subcompressed, with 23 ribs, sculpture similar to that of *V. ventricosa* but feebler, with concentric ridges only in front of the low beaks, and the color paler, the lunule much smaller, and the lunular cardinals thin and feeble. The animal was alive when dredged and appears, from the dried remains, to have had a much smaller foot than *V. ventricosa*.

Venericardia (Cyclocardia) stearnsii Dall, 1902.

Puget Sound, with *V. ventricosa*, U. S. Exploring Expedition under Wilkes.

Shell short, plump, strong, with very high prosogyrate beaks and about 19 strong, rudely nodulous radial ribs with narrower interspaces and a dark-brown pilose periostracum. It has been figured as mentioned under *V. ventricosa*, having been erroneously taken as the type of that species by the writer. It is a much shorter and higher shell with a very small deeply impressed lunule and strong hinge, in which the lunular pustule in the left valve is conspicuous.

Venericardia (Cyclocardia) monilicosta Gabb, 1861.

Pleistocene of Santa Barbara, Cal., Jewett.

This resembles *V. ventricosa* Gould, but is more compressed, very

much more equilateral, and has the lunule and the interspaces between the ribs deeper, and the latter more channeled. It has 17–18 ribs crossed by rounded concentric ridges with the radial channels sharply cross-striated. There are also marked differences in the hinge, which is much more delicate than in *V. ventricosa*. It has not yet been reported living, but is noted here because it has been united with some of the recent species by Gabb and Cooper.

Venericardia (Cyclocardia) incisa Dall, 1902.

Aleutian region, from Unalashka to the Semidi Islands, in 6 to 75 fathoms, sand or mud, Dall.

Shell small, with a polished yellowish-olive periostracum, with 18–20 flat radial ribs separated by linear incised sulci, and crossed by similar concentric sulci; interior white, often with a yellow flush in the cavity of the valves.

Venericardia (Cyclocardia) alaskana Dall.

Arctic Ocean, north of Bering Strait, from Point Barrow south to the Strait and Bering Sea, the south coast of the Okhotsk Sea, the Aleutian Islands, and eastward and southward along the Alaskan coast as far as the harbor of Sitka, in depths varying from 7 to 313 fathoms, with a bottom temperature from 35° to 46.2° F. Also North Japan, in 4–7 fathoms

This species is that which from the Pacific has usually been named *V. borealis* Conrad, and I can only ascribe the long acceptance of this determination, made by Dr. Carpenter, to the absence of a good series of the Eastern shell. After comparing them no one can hesitate to separate them specifically. There is a distance of several thousand miles between their nearest points of approach to each other in range, as far as known. In a general way, until Dr. Stearns looked into the matter in 1890, all the Pacific Cyclocardias were lumped together under the name of *borealis* Conrad.

The present species is ovate, compressed, with 23–25 uniform and elegant radial ribs with narrower interspaces, distinct to the margin of the shell and covered with a dark yellow-brown velvety periostracum, the hairs in close radial lines. The ribs are slightly granular near the low beaks; the lunule narrow and long. The hinge is solid, with the right anterior and posterior cardinals nearly obsolete; the interior is chalky white and is figured in the *Proc. U. S. Nat. Mus.*, XIII, Pl. XVI, fig. 8, under the name of *C. borealis*.

It attains a height of 35, a length of 39, and a diameter of 16 mm. The animal is viviparous and incubates an enormous number of young shells until the adult sculpture is fairly initiated. The brood is fully ripe in August in the Arctic Sea, and about June 1 in the Aleutian Islands. The variability of the shell is chiefly in outline, some specimens being longer than others.

Venericardia (Cyclocardia) rudis Gray, 1839.

Off the Sea Horse Islands, between Point Barrow and Icy Cape, in 23 fathoms, E. E. Smith; south through Bering Strait and Sea, among the Aleutian Islands, and eastward to Kadiak, in 10 to 60 fathoms, bottom temperature 35° to 45° F., Dall.

Shell squarish, compressed, with high, almost posterior beaks; the lunular region deeply indented; the hinge broad and massive; the interior white or more or less tinted with livid purple; sculpture of 12–16 low radial ribs, distally obsolete, with narrower shallow interspaces, with no granulations, covered by a smooth horny brown periostracum, often rude and eroded; height 29, length 31, diameter 16 mm.

Gray, in his description of the shells of Beechey's voyage to the Pacific and Bering Strait, cites *Arcturus rudis* Humphrey, MS., as a synonym of the Pacific shells which he identifies with *Cardita borealis* Conrad. As this is the only name associated with the Bering Strait shells except *borealis*, and it is evident that Gray recognized only one species among them, I have revived the name for the ruder form of the two known to inhabit that region. In well-developed specimens the hinge plate is relatively almost as broad and heavy as in *V. planicosta* Lam. It is easily distinguished from *V. alaskana* by the fewer ribs, smooth periostracum, and prominent beaks with the resulting broad hinge plate.

Venericardia (Miodon) prolongatus Carpenter, 1864.

Middleton Island, Alaska, in Lat. 59° 35′ N., in 12 fathoms, gravel, and south to Neeah Bay at the entrance to the Straits of Fuca.

A small, elevated shell, of pale gray color, and very much the sculpture of *V. incisa*. It is notable for its prominent beaks and oblique form and was figured in the *Proc. U. S. Nat. Mus.*, XIII, Pl. XVI, figs. 7 and 9, in 1890. Like the other species, it is viviparous.

Calyptogena pacifica Dall, 1891.

Clarence Strait, Alaska, in 322 fathoms, muddy bottom, temperature 42.4° F.; U. S. Fish Commission steamer "Albatross." Also fossil in the Pliocene of Los Angeles, Cal.

An oblong, heavy, dull and chalky shell with no radial sculpture and with a grayish-green periostracum over a nearly smooth surface.

Milneria minima Dall, 1871.

Monterey, Cal., south to Cerros Island, Lower California, usually nestling on the backs of the shells of *Haliotis*.

Originally described as *Ceropsis minima*, the generic name being preoccupied, was changed to *Milneria* in 1881. A minute, trapezoidal white shell, of which the females have a dome-shaped indentation on the ventral surface lined and closed by an extension of the mantle, in which the young are incubated. It is figured in *Proc. U. S. Nat. Mus.*, VIII, Pl. XXIV, figs. 4 to 7, and also in Fischer's *Manual*.

Carditella pallida E. A. Smith, 1891.

Port Rosario, Western Patagonia, in 2 to 30 fathoms.

A small fan-shaped whitish shell with an internal resilium and 12 to 15 strong radial ribs. There is a small external ligament.

Carditella semen Reeve, 1843.

Off Mexillones, Atacama Desert, Bolivia, in three fathoms, Cuming.

Ovate, olive-brown, with flattish ribs, very minute.

Carditella tegulata Reeve, 1843.

Valparaiso, Chile, in 25 fathoms, Cuming.

Said by Smith to differ from *C. pallida* by being more inequilateral, less triangular and has only twelve ribs. It is certainly very closely allied.

Carditopsis flabellum Reeve, 1843.

Valparaiso, Chile, Cuming; and the western part of the Straits of Magellan, in 61 fathoms, bottom temperature 47.9°; U. S. Fish Commission steamer "Albatross."

Differs from *C. pallida* by the greater delicacy of the lateral teeth, a larger resilium, and the absence of any external ligament, according to Smith.

Notes.

Cardita nodulosa Lamarck is a Japanese species, but on Valenciennes' plates of the *Voyage of the Venus*, 1846, according to Carpenter, a West American species, probably *C. affinis* Sowerby, 1832, is so named by Valenciennes. In this citation and Carpenter's reprint by the Smithsonian Institution the name is misprinted *modulosa*, both in text and index. In Carpenter's *Report to the British Association*, 1864, p. 287, a "*Cardita incrassatus* Pfeiffer" is cited from the *Proceedings of the Zoological Society* for 1852, p. 157. No such species occurs in the locality mentioned, or anywhere in the *P. Z. S.*, or elsewhere that I have been able to discover. It is, perhaps, a case of misplacement of an index slip in the original MS. *C. incrassata* Conrad is said to be a variety of *C. antiquata*, and is not West American.

Descriptions of New Species.

Venericardia (Cyclocardia) armilla n. sp.

Shell small, rounded, moderately inflated, nearly equilateral, white with a pale brownish periostracum; sculpture of from 17 to 21 well-marked, rounded ribs with subequal interspaces; these ribs are beaded with rounded or ovate nodules and continue to the ventral margin of the valves, the interspaces are conspicuously cross-striated; beaks full, elevated, prosogyrate, with a small, slightly impressed smooth cordate lunule and very narrow escutcheon; inner margins strongly crenate. Height 9, length 8, diameter 6 mm.

U. S. Fish Commission stations 2,399, 2,400 and 2,407, in the northern part of the Gulf of Mexico between the Mississippi delta and Cedar Keys, in 24 to 196 fathoms, bottom temperature 51° to 66° F. U. S. Nat. Mus., No. 93,370.

Venericardia (Cyclocardia) moniliata n. sp.

Shell small, rounded, moderately inflated, nearly equilateral, white, with 20 to 24 radial narrow ribs with wider, cross-striated interspaces; the ribs are sculptured with fine, small, sharp, close-set tubercles, the beaks small, nearly erect, the lunule lanceolate and smooth, the escutcheon similar but longer; internal margins minutely crenate; there is a distinct lateral and socket in each valve, the anterior lateral being in the left valve. Height and length 6.5, diameter 4 mm.

Off Rio Janeiro, Brazil, in 59 fathoms, bottom temperature 57° F. U. S. Nat. Mus., No. 96,132.

Venericardia (Cyclocardia) Gouldii n. sp.

Shell thin, ovate, inequilateral, moderately inflated with about 23 low, broad, rounded ribs with much narrower shallow interspaces, the anterior ribs slightly crenulated by fine transverse ridges, the ribs behind the umbones nearly smooth, covered by a yellowish-brown periostracum; lunule very small and impressed, escutcheon linear; inner margin crenulated below, hinge plate delicate, narrow, without marked laterals. Height 13.5, length 16.5, diameter 8 mm., the beaks somewhat eroded.

This species may possibly be a variety of *V. ventricosa*, corresponding in its relation to that species with *V. novangliæ* Morse, in its relation to *V. borealis*. But the probabilities are against it. The measurements of the two most related and geographically most adjacent forms are as follows:

V. ventricosa, height 17.5, length 19, diameter 15.5 mm.

V. stearnsii, height 14.5, length 13.5, diameter 11 mm.

Only one, a living specimen, of *V. Gouldii* was obtained at a depth of 822 fathoms, off San Diego, Cal. U. S. Nat. Mus., No. 109,270.

Venericardia (Cyclocardia) incisa n. sp.

Shell small, polished, with a smooth lively olive-green periostracum over 18 to 20 flat radial ribs separated by linear incised sulci and crossed by similar concentric sulci, about as distant as the ribs are wide, lunule almost obsolete, no escutcheon visible; beaks moderately high, somewhat anterior; hinge delicate, internal margins strongly crenate; siphonal end of the valves usually overgrown by a commensal minute hydroid; height 10, length 9.5, diameter 5.3 mm.

Numerous specimens were obtained at different localities. The types were compared with the Carditas in most of the Museums of Northern Europe and appeared distinct. Type from Unalashka in 16 fathoms. U. S. Nat. Mus., No. 109,267.

Venericardia (Cyclocardia) stearnsii Dall.

Venericardia ventricosa Gould, Proc. U. S. Nat. Mus., XIII, p. 216, 1890, *ex parte;* and Pl. XVI, figs. 5, 6.

Puget Sound

Venericardia (Cyclocardia) alaskana Dall.

Venericardia borealis Conrad, Proc. U. S. Nat. Mus. XIII, p. 216, 1890, *ex parte ;* and Pl. XVI. fig. 8.

Bering Sea.

Cardita (Glans) sulcosa n. sp.

Shell small, trapezoidal, with small elevated prosogyrate beaks, the lunule small and deeply impressed, escutcheon linear; from the beaks a wide and shallow sulcus extends to the lower posterior margin which it distinctly emarginates; sculpture of about 23 flat-topped ribs with much narrower channeled interspaces ; the ribs are crossed by concentric elevated ridges, thus producing annulations which are more conspicuous on the sides than at the top of the ribs; the coloration is of dark-brown, red-brown and white, more or less articulated on the ribs; interior white, the margins strongly crenulated. Height 7.5, length 8.5, diameter 6.5 mm.

The only form with which this might be confused is the young of *C. cuvieri*, which is less quadrate and has coarser sculpture and fewer ribs.

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